What Is Claimed Is:

1. A single phase compound represented by the nominal general formula $LiFe_{1-y}M_yPO_4$ where $0 < y < 0.5$ and M is at least one metal selected from the group consisting of Mg, Ca, Zn, Sr, Pb, Cd, Sn, Ba, Be, and mixtures thereof.

2. The single phase compound of claim 1 where $0 < y \leq 0.2$.

3. The single phase compound of claim 1 having the nominal formula $LiFe_{1-y}Mg_yPO_4$.

4. The single phase compound of claim 1 having the nominal formula $LiFe_{0.9}Mg_{0.1}PO_4$.

5. The single phase compound of claim 1 having the nominal formula $LiFe_{1-y}Ca_yPO_4$.

6. The single phase compound of claim 1 having the nominal formula $LiFe_{0.9}Ca_{0.1}PO_4$.

7. The single phase compound of claim 1 having the nominal formula $LiFe_{1-y}Zn_yPO_4$.

8. The single phase compound of claim 1 having the nominal formula $LiFe_{0.9}Zn_{0.1}PO_4$.

9. The single phase compound of claim 1 which has an olivine structure.

10. A single phase compound having the nominal general formula $LiMI_{1-y}MII_yPO_4$ where MI is selected from the group consisting of Fe, Co, Ni, Mn, Cu, V, Sn, Ti, Cr, and mixtures thereof, and MII is selected from the group consisting of Mg, Ca, Zn, Sr, Pb, Cd, Sn, Ba, Be, and mixtures thereof, and where y is greater than zero and less than one.

11. An olivine compound having the nominal general formula $LiM_{1-y}M_yPO_4$ where MI is at least one transition metal selected from Groups 4 to 11 inclusive of the Periodic Table and has a +2 valence state, MII is at least one metallic element which is selected from Groups 2, 12, and 14 of the Periodic Table and has a +2 valence state, and where $0 < y < 1$.

12. The compound of claim 11 wherein MI is selected from the group consisting of V, Cr, Mn, Fe, Co, Cu, and mixtures thereof.

13. The compound of claim 11 wherein MII is selected from the group consisting of Mg, Ca, Ba, Zn, and mixtures thereof.

14. An electrode comprising a binder, an electrically conductive carbonaceous material, and an active material represented by the nominal general formula $LiFe_{1-y}M_yPO_4$ where $0 < y < 0.5$ and M is at least one metal selected from the group consisting of Mg, Ca, Zn, Sr, Pb, Cd, Sn, Ba, Be, and mixtures thereof.

15. The electrode of claim 14 wherein said active material is a single phase compound where

$0 < y \leq 0.2$.

16. The electrode of claim 14 wherein said active material is a single phase compound having the nominal formula $LiFe_{1-y}Mg_yPO_4$.

17. The electrode of claim 14 wherein said active material is a single phase compound having the nominal formula $LiFe_{0.9}Mg_{0.1}PO_4$.

18. The electrode of claim 14 wherein said active material is a single phase compound having the nominal formula $LiFe_{1-y}Ca_yPO_4$.

19. The electrode of claim 14 wherein said active material is a single phase compound having the nominal formula $LiFe_{0.9}Ca_{0.1}PO_4$.

20. The electrode of claim 14 wherein said active material is a single phase compound having the nominal formula $LiFe_{1-y}Zn_yPO_4$.

21. The electrode of claim 14 wherein said active material is a single phase compound having the nominal formula $LiFe_{0.9}Zn_{0.1}PO_4$.

22. The electrode of claim 14 wherein said active material has an olivine structure.

23. An electrode comprising a binder, an electrically conductive carbonaceous material and an active material which is an olivine compound represented by the nominal general formula $LiM_{1-y}M_yPO_4$ where MI is at least one transition metal selected from Groups 4 to 11

inclusive of the Periodic Table and has a +2 valence state, MII is at least one metallic element which is selected from Groups 2, 12, and 14 of the Periodic Table and has a +2 valence state, and where $0 < y < 1$.

24. The electrode of claim 23 wherein MI is selected from the group consisting of V, Cr, Mn, Fe, Co, Cu, and mixtures thereof.

25. The electrode of claim 23 wherein MII is selected from the group consisting of Mg, Ca, Ba, Zn, and mixtures thereof.

26. A lithium ion battery comprising:

a first electrode having an active material represented by the general formula $LiFe_{1-y}M_yPO_4$ where $O < y < 0.5$ and M is at least one metal selected from the group consisting of Mg, Ca, Zn, Sr, Pb, Cd, Sn, Ba, Be, and mixtures thereof;

a second electrode which is a counter-electrode to said first electrode; and

an electrolyte between said electrodes.

27. The battery of claim 26 wherein said active material is a single phase compound where $O < y \leq 0.2$.

28. The battery of claim 26 wherein said active material is a single phase compound having the nominal formula $LiFe_{1-y}Mg_yPO_4$.

29. The battery of claim 26 wherein said active material is a single phase compound having the nominal formula $LiFe_{0.9}Mg_{0.1}PO_4$.

30. The battery of claim 26 wherein said active material is a single phase compound having the nominal formula $LiFe_{1-y}Ca_yPO_4$.

31. The battery of claim 26 wherein said active material is a single phase compound having the nominal formula $LiFe_{0.9}Ca_{0.1}PO_4$.

32. The battery of claim 26 wherein said active material is a single phase compound having the nominal formula $LiFe_{1-y}Zn_yPO_4$.

33. The battery of claim 26 wherein said active material is a single phase compound having the nominal formula $LiFe_{0.9}Zn_{0.1}PO_4$.

34. The battery of claim 26 wherein said active material has an olivine structure.

35. A lithium ion battery comprising:

a first electrode having an active material which is an olivine compound represented by the nominal general formula $LiM_{1-y}M_yPO_4$ where MI is at least one transition metal selected from Groups 4 to 11 inclusive of the Periodic Table and has a +2 valence state, MII is at least one metallic element which is selected from Groups 2, 12, and 14 of the Periodic Table and has a +2 valence state, and where $0 < y < 1$;

a second electrode which is a counter-electrode to said first electrode; and

an electrolyte between said electrodes.

36. The battery of claim 35 wherein MI is selected from the group consisting of V, Cr, Mn, Fe, Co, Cu, and mixtures thereof.

37. The battery of claim 35 wherein MII is selected from the group consisting of Mg, Ca, Ba, Zn, and mixtures thereof.

38. A single phase compound represented by the nominal formula LiV_2O_5 and having an orthorhombic crystal structure with a = 9.7 ± 0.2Å, b = 3.6 ± 0.2Å and c = 10.6 ± 0.2Å.

39. The compound of claim 38 which is prepared by reacting vanadium pentoxide and lithium compound in the presence of carbon at an elevated temperature sufficient to form said single phase compound.

40. An electrode comprising a binder, an electrically conductive carbonaceous material and an active material which is a single phase compound represented by the nominal general formula LiV_2O_5 and having an orthorhombic crystal structure with a = 9.7 ± 0.2Å, b = 3.6 ± 0.2Å and c = 10.6 ± 0.2Å.

41. A lithium ion battery comprising:

a first electrode having an active material which is a single phase compound represented by the nominal formula LiV_2O_5 and having orthorhombic crystal structure which a = 9.7 ± 0.2Å, b = 3.6 ± 0.2Å and c = 10.6 ± 0.2Å;

a second electrode which is a counter-electrode to said first electrode; and

an electrolyte between said electrodes.